



# PATENT SPECIFICATION

DRAWINGS ATTACHED

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## COMPLETE SPECIFICATION

### Surgical Table

We, RITTER COMPANY, INC., of 400 West Avenue, Rochester, New York, United States of America, a corporation of the State of Delaware, United States of America do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to surgical tables, in particular surgical operating tables designed to give the surgeon maximum anatomical exposure within the patient's wound and which includes an improved and novel arrangement for enabling the anaesthetist to maintain the patient's physiological functions.

In terms of surgery, the human skeletal structure articulates at the cervical spine, lumbar arch, and the hip and knee joints. These articulations divide the body into five major regions, the head, the spinal or back section, the pelvic or seat section, the femoral or upper leg section and the lower leg section. For the most advantageous surgical exposure, these five major regions should assume a tolerable anatomical contour appropriate to the particular procedure, with physiological distribution of the body-weight over the surface of the operating table. However, it is obviously impossible to conform or "fit" these five major body regions with the body articulations therebetween to conventional commercial operating tables having only four articulated sections. Consequent malpositioning of the patient is frequently inevitable with present commercial surgical tables. This serious limitation of present tables often restricts the surgical team from obtaining favourable access to the operative site, especially when managing or controlling physiological deterioration of the patient.

It is therefore an object of the present invention to reduce and, for the most part, avoid these restrictions, and for this purpose we have conceived and evolved an entirely new approach to the problem of providing the

surgical team with true postural control of the patient.

According to the present invention a surgical table is provided comprising at least five table sections for receiving portions of a patient thereon, which includes a head section, a spinal section, a pelvic section, a femoral section and a lower leg section, each of said five sections being articulated with respect to the adjacent section or sections whereby each of said sections is capable of angular movement with respect to its adjacent section or sections, and the length of each of the three intermediate sections being such that for a patient of a given height when the articulation between the head section and the spinal section is located at the neck, the articulation between the spinal section and the pelvic section is located at the lumbar arch, the articulation between the pelvic section and the femoral section is located at the hip joint and the articulation between the femoral section and the lower leg section is located at the knee joints. In this respect it is intended that the term "articulated" means pivotally jointed or connected such as between two sections whereby relative angular movement between these sections is possible.

Differences in the dimensions of patients as far as the neck to the top of the head and as far as the knee joints to the feet are concerned are immaterial as regards the construction of the table sections because they are the end sections of the table and they, particularly the lower leg section, can be made long enough to accommodate all patients.

Fortunately moreover, the variation in pelvic lengths between short and tall adult persons and children in the teen ages is minimal, although the differential in both the spinal and femoral lengths is extensive. To meet this problem, the back and femoral sections on the operating table according to the invention are preferably telescopic and adjustable in length. Thus, in this preferred form an

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operating table is provided which ensures true contour correspondence between the articulations of the table and the articulations of human anatomy for adult or teen-age patients over a large range of heights extending above and below the preselected height which is decided upon prior to manufacture of the table.

The invention initiates or makes possible new techniques for the care of the patient at operation. Due to the unique construction of the table top of the present invention, these techniques are available without changing the original position of the operating site. Hypotension induced by surgery and anaesthesia may now be controlled in many cases by the simple expedient of elevating the lower extremities and allowing venous gravity-return to the heart. This may be done without placing the entire table in Trendelenburg position. The operative site and other organs superior to it may remain in their original position instead of being shifted in a steep downward tilt, thus disturbing the surgical team with the incidental movement of the table and the need for refocusing the surgical light.

The five sections of the table construction are preferably each controlled, either manually or by power, independently of the other, thereby enabling the elevation of the femoral and leg sections and allowing venous gravity to the heart without placing the entire table in Trendelenburg.

An advantage of the present invention is that, by use of five sections articulated in the manner set forth herein and preferably supported from a central seat or pelvic section, in many cases the Trendelenburg position can be avoided with its consequent change in the position of the operative site merely by swinging the femoral and leg rest sections upward about the articulation between the pelvic and femoral sections.

Elevation of the lower extremities at the hip joint is most desirable in many situations. Venous stasis in the legs may be reduced by their elevation during the operation. Such elevation likewise reduces the amount of abdominal muscular tension and may reduce the total amount of relaxant drug needed. Such elevation would be helpful during all types of pelvic and abdominal latarotomies. Moreover, hypotension induced by the rapid change from lithotomy position to the flat supine may in many cases be prevented or at least reduced by elevation of the femoral and leg rest section and then gradual reduction in the height of the legs by pivoting the femoral section of the table about the pivot between the femoral section and the pelvic section.

Sudden changes in position such as occur in the operation of abdominoperineal resection are frequently accompanied by hypotension. This table is uniquely suited to this situation in that adjustment of the patient from supine

to lithotomy position may be made without having to move the patient to the foot-end of the table during the operation.

Still another advantage of the invention is to provide a table in which movement of the patient on the table during an operation is minimized, this fact being particularly important in abdominoperineal resections where movement of the patient on the table frequently causes hypotension.

Drainage of the Tracheobronchial tree during abdominal latarotomies is facilitated by lowering of the back and head section of the table without disturbing the abdominal site of operation.

Additionally the invention has the advantage of lowering or raising of the back and head section without moving the pelvic section and disturbing the operative site as, for example, during abdominal latarotomies or in placing the patient in the Kraske position.

When in the Kraske position excessive pooling of blood in the upper extremity of the body may be prevented by elevation of the spinal section of the table which articulates at the lumbar arch.

Malposition of the patient on the table reflects in an adverse manner upon the physiology of respiration and circulation. In addition, there may be nerve injuries to the patient. The five sections of the table allow for separate adjustments in the critical areas without the usual shifting of the patient upon the table. Back sprain, which so frequently accompanies the relaxed supine position, is easily mitigated by simple flexion of the table in the lumbar area with elevation of the legs from the hip joint.

The present invention further contemplates a table of five sections articulated in a manner corresponding to the articulations of the body with two sections of the table being adjustable in length to accommodate patients of a range of heights, this adjustment together with the locations of the articulations minimizing malpositioning of the patient and shifting the patient on the table thereby minimizing nerve injuries to the patient and back sprains.

In order that the invention may be more readily understood a preferred embodiment thereof is described below in conjunction with the accompanying drawings, in which:

Fig. 1 shows a top plan view of a five section table according to the present invention;

Fig. 2 shows a side elevation thereof;

Fig. 3 shows a schematic view showing the five sections of the table and indicating the articulation joints therebetween;

Fig. 4 shows a schematic view similar to Fig. 3 showing the spinal section and the femoral section, telescopically shifted so as to increase the length of the table to accommodate persons of larger stature;

Fig. 5 shows a sectional view taken sub-

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stantially along the line 5—5 of Fig. 1 in the direction indicated by the arrows;

Fig. 6 shows a partial sectional view of the bottom of the table and indicates how a part of the femoral section may be telescopically shifted and located as desired with respect to another part, showing how the telescopically movable part may be removed from the other part and showing how the leg rest section may be removed from and locked with respect to the telescopically movable femoral part;

Fig. 7 shows a partial sectional view of the head end of the spinal section;

Fig. 8 shows a top plan view of the head rest section; and

Figs. 9 to 14 inclusive, show diagrammatically some of the very many positions into which the table may be swung and the sections articulated.

As shown in the drawings, the surgical table of this invention comprises a table as shown in Application No. 28259/61 (Serial No. 990,737) having a table surface, generally indicated by the numeral 31, for the reception of the patient. The metal table surface is adapted to receive one or more cushions (not shown) for the comfort of the patient. The table includes a base 32 from which the table surface is supported; pump and motor housing, generally indicated by the numeral 33; a control box, generally indicated by the numeral 34, which houses the valves for actuating the various hydraulic mechanisms; and a plurality of control handles 36, in this case five, for separately controlling each of the operations of raising and lowering the various sections with respect to each other, raising and lowering the table surface 31 as a whole and laterally and longitudinally tilting the table. Figs 9 to 14 show diagrammatically a few of the more important positions, from a surgical standpoint, in which the patient may be placed.

The base 32 is mounted on four casters 37 which are provided with locking means (not shown) to hold the casters against movement when the table is in use.

A pedestal or support column, generally indicated by the numeral 38, is mounted on the base 32 and supports the table or table surface 31. The table comprises five sections: a headrest section 39, a spinal or back section 41—41<sup>1</sup> (Figs. 3 and 4), a pelvic or seat section 42, a femoral section 43—43<sup>1</sup> (Figs 3 and 4), and a foot or leg rest section 44. The headrest section 39 is manually operated, as hereinafter described, the spinal section is operated by a hydraulic piston and cylinder assembly, generally indicated by the numeral 46, and the femoral section 43 is operated by a hydraulic piston and cylinder assembly indicated by the numeral 47.

Referring now to Fig. 2 the table 31 is raised and lowered by a hydraulic piston and cylinder assembly, not shown herein. Lateral

tilt of the table about a longitudinal axis is accomplished by a cylinder and a piston assembly, generally indicated by the numeral 49. Movement of the table to Trendelenburg (Fig. 9) or reverse Trendelenburg (Fig. 11) positions, that is, pivoting the table about a horizontal transverse axis, is accomplished by a piston and cylinder assembly generally indicated by the numeral 51.

The primary functions of the table are power-operated and controlled and the above-mentioned hydraulic cylinders are fed with oil under pressure pursuant to actuation of the control handles 36 to actuate the table sections in accordance with the necessities of the surgical operation being performed.

Referring to Fig. 5, depending below and integral with the pelvic section of the table top, is a bifurcated bracket or boss 216 which is connected to the upper end of a piston rod 217 secured to the piston of the Trendelenburg cylinder 51 by a universal joint 218.

Referring now to Figs. 1 and 2, the table includes side rails 261, 262 and 263 on each side of the table. The side rails are rigidly secured to the various sections by means indicated at 264 having spacers 265 (Fig. 5) mounted thereon. These side rails are for the purpose of adjustably holding clamps for arm rests, leg rests, or stirrups, an anaesthetic screen and other removable accessories with which the table may be equipped. Between the pelvic section and the spinal section, these side rails are overlapped and formed with openings to receive hinge pins 266 on opposite sides of the table.

Depending from the pelvic section 42 (Fig. 5) are a pair of bosses 291 which have a cutout 292 between them. A pair of support plates 293 are fixed by means of a plurality of screws 294 threaded into the bosses and pass through the plates 293. Carried at the lower end of the femoral cylinder 47 are a pair of pivot pins 296 which are supported in the bottom of the cylinder and extend outward through apertures 297 in the plates 293. The femoral cylinder 47 is free to swing about the axis of the pivot pins 296.

The femoral cylinder has a piston mounted therein to either side of which oil may be admitted. Simultaneously with the application of oil to one side of the piston, oil is exhausted back to a sump from the other side thereof. A piston rod 298 is secured to the piston (Fig. 5) and is pivoted to a boss depending from the lower side of the femoral section 43. Part of the mechanism for articulating the femoral section is shown in Fig. 5.

Referring now to Fig. 1 (see also Figs. 3 and 4) the pelvic section has what is known in the art as a perineal cutout 331. When the table is to be used for perineal operations, the femoral section must be moved to an out-of-the-way position so that the surgeon

is able to be seated close to the perineal cutout. For this reason, the compound movement of the femoral section is necessary.

As shown in Fig. 6 which is a sectional view of the underside of the femoral and leg rest table sections, the leg rest section 44 is removable from the femoral section 43<sup>1</sup>. For this purpose the femoral section has an adapter 351 secured thereto by screws on each side of the table. Each adapter has a track or ways 352 therein for the reception of a slide member 353 mounted on the leg rest section 44. The slide member 353 on each side of the table has a finger piece 356 which is pivoted at 354 by which the finger piece may be swung about the pivot 354. The end of the finger piece has a locking pin 357 pivoted thereto which fits into a bore 358 formed in the adapter 351 end of the femoral section. A spring 359 normally holds the slide member in the position of the parts shown in Fig. 6.

When the foot section is to be removed, the finger pieces 356 on each side of the table are pressed inward against the action of springs 359 to withdraw locking pins 357 from the bores 358. The slide members 353 may then be moved to the right, as viewed in Fig. 6, in the ways 352 and the foot section slid off the end of the femoral section. When replacing the foot section, the opposite of this operation is performed.

In most adults, the difference in their heights primarily occurs in their legs and in their spinal or back sections. For this reason the back or spinal section 41 and the femoral section 43 are made adjustable in length. The means for adjustment of the length of these two sections is the same so that a description of one will suffice.

In Fig. 4 the fixed spinal section has been indicated by the numeral 41<sup>1</sup> while the movable spinal section has been indicated by the numeral 41. The spinal cylinder 46 is pivoted to the fixed section 41<sup>1</sup>. Similarly the fixed femoral section has been indicated by the numeral 43<sup>1</sup> and the movable femoral section by the numeral 43. The femoral hydraulic cylinder 47 is pivoted to the fixed femoral section 43<sup>1</sup>.

The adjustability of the spinal and femoral sections is illustrated in Fig. 6. The fixed femoral section 43<sup>1</sup> is shown at the left of Fig. 6. To enable this adjustability and removability of the adjustable section 43, the underside of the fixed section 43<sup>1</sup> is provided with a track or ways 360 on each side thereof. One side of each of the ways has a plurality of, in this case five, openings or bores 362 for the reception of locking pins 363. Rollers 364 are rotatably mounted on pins 366 suitably fixed to the movable femoral part 43.

The locking pin 363 is normally pressed toward locking relation with one of the bores 362 by a spring 370 mounted in a recess

which seats in a part of the casting and presses against a snap ring 365 mounted in a groove formed in the locking pin 363. A fitting 367 is secured to the locking pin and receives an eccentric pin 368. The eccentric pin is eccentrically secured to a rotatable member 369 mounted on a shaft 371 which has a flat side. A bearing member 372 is located in a bore formed in a wall 374 formed on the underside of the removable section 43. The bearing member 372 is fixed and the shaft rotates within it. A set screw 373 extending through the casting holds the bearing member against movement longitudinally and rotationally in the bore. The shaft 371 has a flat extension 376 which is secured in any suitable manner to a hand release piece 377. Upon loosening and resetting the set screw 370<sup>1</sup>, hand release piece 377 may be set as desired.

It will now be understood that upon moving the hand release piece, the shaft 371 will be rotated and the eccentric pin 361 will rotate to reciprocate the fitting 367. This action will withdraw the locking pin 363 against the action of spring 370 from the particular bore 362 in which it is seated. The movable section 43 may then be shifted with relation to the fixed section to the desired position as diagrammatically illustrated in Fig. 4. In Fig. 3 the movable spinal section 41 and the movable femoral section 43 have been superimposed over the fixed sections 41<sup>1</sup> and 43<sup>1</sup> respectively. In Fig. 4 the spinal and femoral sections have been extended their maximum distance. As will be apparent from Fig. 6, the movable femoral section 43 may be completely removed from the fixed section 43<sup>1</sup>. Similarly, the movable spinal section 41 may be completely removed from the fixed spinal section 41<sup>1</sup>. A stop pin 375 and cutout stop plate 361 (Fig. 6) prevent unintended removal when extending the section. In order to remove the section, it has to be lightly lifted when the stop pin touches the stop plate.

In the performance of certain operations the upper legs must be raised while the lower legs may be allowed to retain their original position or may be raised if desired. Such a position is illustrated in Fig. 13. A similar raising of the upper legs may be accomplished merely by activating the femoral cylinder to allow venous gravity-return to the heart. This avoids the necessity of placing the entire table in Trendelenburg and interrupting an operation on the upper part of the body. Other surgical situations exist where the upper legs must be raised and the lower legs lowered.

The combination of the particular articulation of the femoral section with respect to the pelvis section and the length adjustability of the femoral section enables the positioning of the parts 43 and 44 of Fig. 13 without causing pressure on any part of the legs. By adjusting the length of the femoral section to fit the patient so that the joint between

the femoral section and the leg rest section lies directly below the knee joint, the femoral section may be raised without changing the relationship of the knee joint with respect to the joint in the table. This is so because the femoral sections swings about an axis above the table surface as described in the Application No. 29106/61 (Serial No. 990,739). Cases have been known, when using present surgical tables and failure of the surgical team to use adequate additional padding, where the legs of the patient had to be amputated due to long exposure of the lower legs to pressure.

The head rest section 39 is removable from the spinal section 41 as will presently appear. Thus the head rest section 39, the removable spinal section 41, the removable leg rest section 44 and the removable femoral section 43 may all be removed from the table leaving only the seat or pelvic section 42 and the short sections 41<sup>1</sup> and 43<sup>1</sup> articulated with respect to the pelvic sections. All the actuating elements previously described are operatively connected to these sections.

Referring now to Fig. 2, the head rest section 39 has been shown. The head rest 39 may be swung about a pivot 386 secured to an arm 387, the end of which is split at 388. The head rest assembly may pivot about a pivot 389 and be locked in any desired adjusted position. For this purpose the arm 387 is split at 391 and a hand operated clamp 392 opens and closes the gaps at 388 and 391, to release the head rest assembly to enable it to be shifted and locked in a desired adjusted position. The head rest, for example, may be shifted so that it hangs downward normal to the plane of spinal section 41 or at its other extreme rests on the spinal section either normal thereto or at a tilt angle. The single hand lever locks both clamps 388 and 391. The specific manner in which this is accomplished is old and well known and per se does not constitute part of the present invention.

As previously mentioned the head rest section is removable from the spinal section 41. This is illustrated in Fig. 8. For this purpose attached to the arm 387 is a connecting piece 401 which has a bracket 402 secured thereto. The bracket 402 has two forks 403 rigidly secured thereto which fit into bores 404 formed in the underside of the spinal section 41. The forks are locked in the bores by hand clamps 406 the ends of which engage the forks. Within limits the head rest assembly may be shifted toward and away from the spinal section 41. The head rest assembly has side extensions 407 which carry side rails 408. The side rails are for the purpose of supporting an anaesthetic screen assembly and for this reason are movable with the head rest.

The leg rest section 44 is releasably locked

with respect to the movable part 43 of the femoral section. This locking means, located on the underside of the leg rest section, comprises a multiplicity of discs only two of which, 410 and 409, have been shown in Fig. 6. The discs 410 are splined to a casing 411 while the discs 409 are splined to a shaft or rod 412 as shown at 413.

A hand release lever 414 extends below the end of the leg rest section, is supported in any suitable manner and has adjustable stops 416. The inner end of the lever 414 is fitted to a cam 417 which has two flat spots 418 and 419. The cam 417 actuates a pair of pushrods 421 and 422 through rollers riding on the cams. The pushrods include threaded members 423 having nuts 424 thereon threaded into sockets in the pushrods. A U-shaped mounting 425 for slidably receiving the pushrods is supported from the leg rest section. A spring 426 coiled in a cage 427 carried by the leg rest section is extended and tied to the hand release lever 414 as shown at 428.

In the solid line position of the release lever 414, the cam is rotated from the position of Fig. 6 and the pressure of the spring and the action of the cam is such as to exert pressure on pressure members 430 rigidly connected to the threaded members 423. The force exerted on the pressure members 430 may be varied by adjusting the nuts 424.

The casing 411 is fixed to the leg rest section and rotates with it about the axis of the shaft 412. The shaft 412 is fixed to the slide member 353. When pressure is applied on the outer plate 410, the discs are free to shift and apply pressure between the discs 410 and 409 and since the shaft 412 is fixed in position, the casing 411 is rigidly held and the leg rest is locked in the desired adjusted position with respect to the movable part 43 of the femoral section.

To release the leg rest section the hand release lever is shifted to the dotted line position which frees the discs 410 and 409 from frictional engagement and permits rotation of the leg rest section about the axis of the shafts 412. When the leg rest section reaches the desired position of adjustment, the hand release lever is released and the spring 426 snaps the cam 417 to locking position to apply pressure on the discs and lock the leg rest in the adjusted position. The action is therefore a self-locking one. Moreover, because the locking mechanism is approximately on the axis of articulation, the leg rest section may be rotated through an arc of 180° or more. Angular locked positions of the leg rest with respect to the movable part 43 of the femoral section are shown in Figs. 13 and 14.

Adults and teen-agers vary greatly in height but most of this variation occurs in the legs and the upper trunk. Variations in length

from the neck upward and from the knees downward are unimportant as these are the end sections of the table and in any event the head rest section can be adjusted with respect to the spinal section as indicated in Figs. 7 and 8. The variation in length of the pelvic section in adults and teen-agers is not great. Therefore, by adjusting the length of the spinal section and the femoral section the table may be made to fit most adults and teen-agers. By adjusting these sections and adjusting the headrest with respect to the femoral section, the articulation between the headrest and the spinal section may be located directly under the neck; the length of the spinal section may be adjusted to conform to the length of the back of the patient; the articulation of the spinal section with respect to the pelvic section will be substantially under the lumbar arch; the articulation between the pelvic section and the femoral section will be substantially under the hip joint; and the femoral section may be adjusted in length to conform to the length of the upper legs of the patient so that the articulation between the leg rest section and the femoral section is directly under the knee joint.

Moreover, as previously mentioned and more fully described in the above mentioned applications, upon removal of the leg rest section and the removable part of the femoral section, the remainder of the femoral section may be swung downward and out of the way to enable access to the perineal cutout 331.

In Figs. 9 to 14 inclusive there are shown a few representative positions in which the table of the present invention may be placed, but it will be appreciated that many more positions of the table sections are possible. Fig. 9 shows the Trendelenburg position for venous return to the heart. The anaesthetist places the patient in this position when necessary during surgery. However, because the table can be articulated at the pelvis, venous return can usually be accomplished with the table, for example, in the position of Fig. 10, merely by swinging the femoral and leg rest sections about the articulation between the pelvic and femoral sections.

The position of the table sections shown in Fig. 11 is known as the reverse Trendelenburg position. This position of the table sections is employed in, for example, thyroidectomy and in gall bladder surgery.

The position of the table sections shown in Fig. 12 is used in kidney and chest surgery. The position of the table sections (Fig. 13) either with or without the headrest removed, is employed in neurosurgery and in craniotomy. The position shown in Fig. 14 either with the head rest section as shown or placed at right angles to and on the top of the spinal section is employed in Culdoscopic and sigmoidoscopic examinations and operation.

It will be appreciated that in all the positions of the table sections shown and many others, the table may be adjusted and tailored to fit the patient with the attendant minimizing of pressure points and shock during surgery.

While the preferred form of mechanism of the invention has been shown and described it will be apparent that various modifications and changes may be made therein, particularly in the form and relation of parts, without departing from the scope of the invention as set forth in the appended claims.

#### WHAT WE CLAIM IS:—

1. A surgical table comprising at least five table sections for receiving portions of a patient thereon, which includes a head section, a spinal section, a pelvic section, a femoral section and a lower leg section, each of said five sections being articulated with respect to the adjacent section or sections whereby each of said sections is capable of angular movement with respect to its adjacent section or sections, and the length of each of the three intermediate sections being such that for a patient of a given height when the articulation between the head section and the spinal section is located at the neck, the articulation between the spinal section and the pelvic section is located at the lumbar arch, the articulation between the pelvic section and the femoral section is located at the hip joint and the articulation between the femoral section and the lower leg section is located at the knee joints.

2. A surgical table as claimed in claim 1, in which at least one of the sections is adjustable in length.

3. A surgical table, as claimed in claim 1 or 2, in which the spinal section has two parts which are arranged to be telescoped to vary the length of the spinal section.

4. A surgical table as claimed in claim 1, 2 or 3, in which the femoral section has two parts which are arranged to be telescoped to vary the length of the femoral section.

5. A surgical table as claimed in any preceding claim, which includes a perineal cutout in the pelvic section.

6. A surgical table as claimed in claim 5, in which the perineal cutout in the pelvic section is provided at the transverse edge thereof adjacent the femoral section and the femoral section and the leg section are arranged to be moved out of the way to enable a surgeon to gain access to the patient through the perineal cutout.

7. A surgical table as claimed in any preceding claim, which includes means in the table sections for changing the location of at least two of the points of articulation with respect to the pelvic section.

8. A surgical table as claimed in any preceding claim, in which the spinal section and the femoral section are arranged to be raised

and lowered independently of each other without changing the position of the pelvic section.

9. A surgical table as claimed in any preceding claim, in which the head rest section and the leg rest section are both removable.

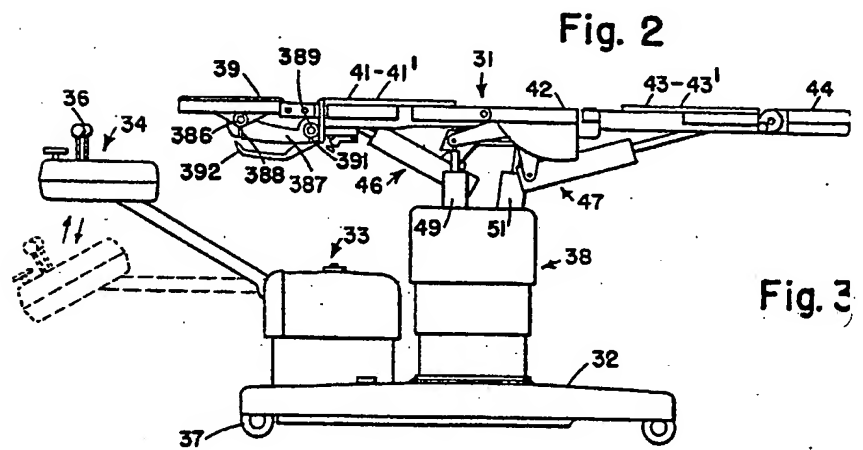
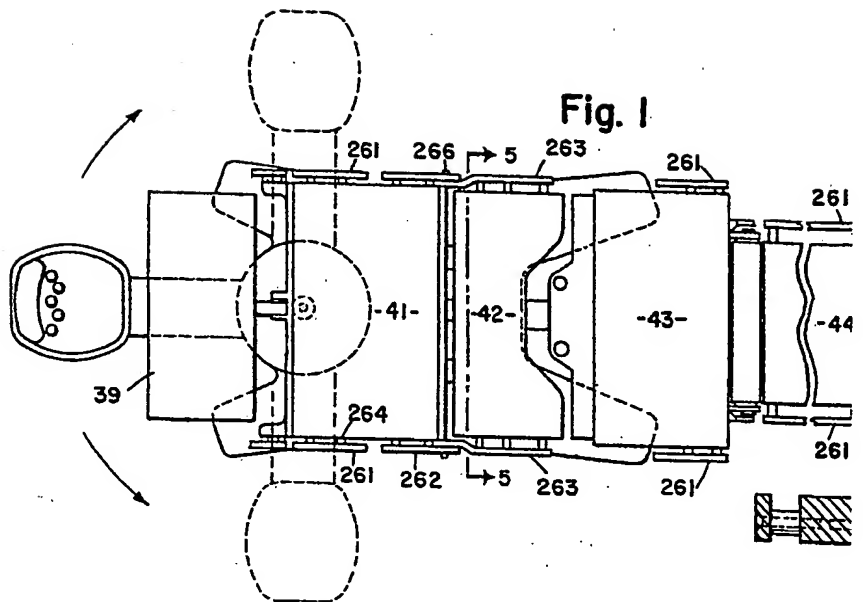
5 10. A surgical table as claimed in any preceding claim, in which the spinal section and the femoral section each comprises two telescopic parts, one of the telescopic parts being  
10 removable leaving the two remaining parts still articulated with respect to the pelvic section.

11. A surgical table as claimed in any preceding claim, which includes side rails for an anaesthetic screen rigidly attached to the head rest section. 15

12. A surgical table substantially as hereinbefore described and as shown in Figs. 3 and 4 of the accompanying drawings.

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**Fig. 3**

**Fig. 4**



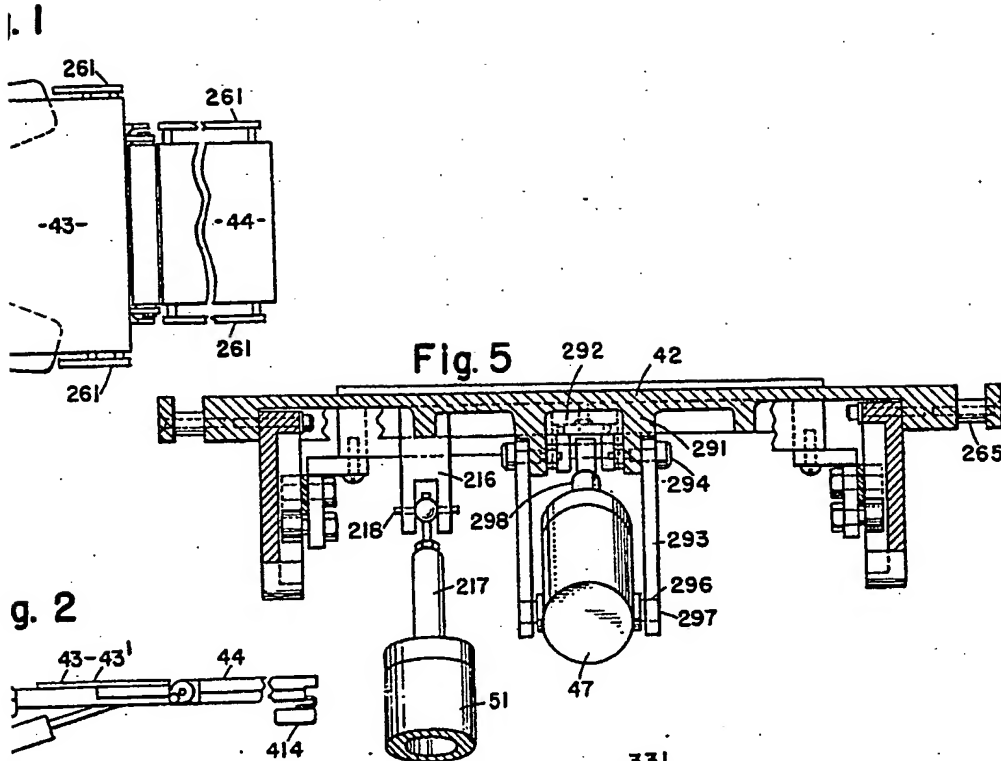


Fig. 3

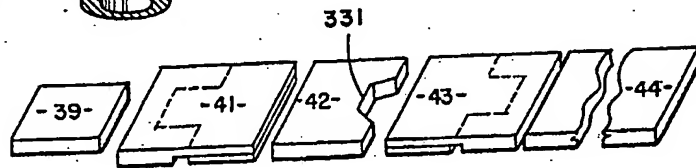
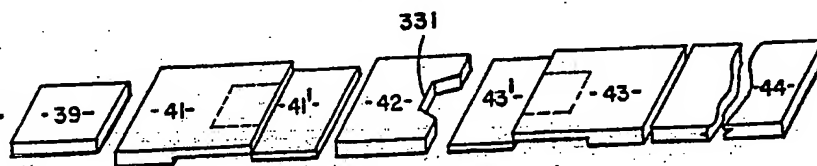


Fig. 4



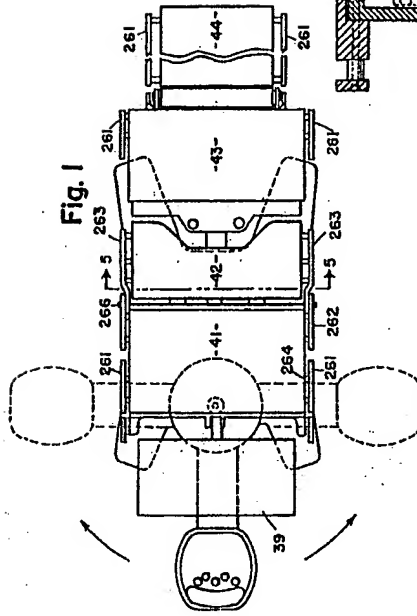


Fig. 1

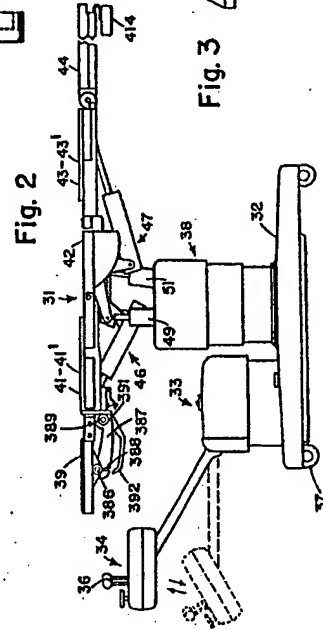


Fig. 2

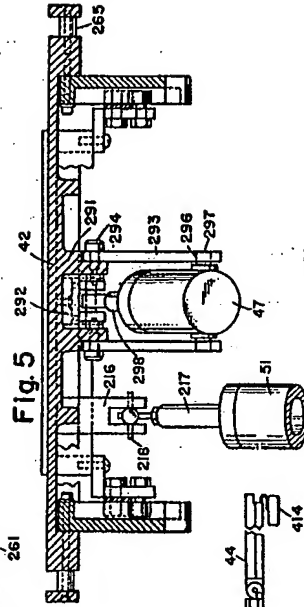


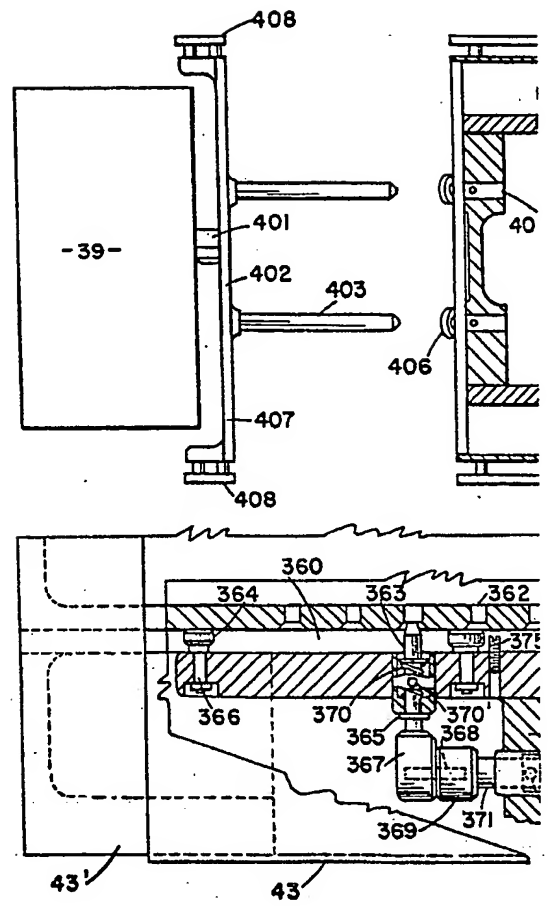
Fig. 5



Fig. 3



Fig. 8

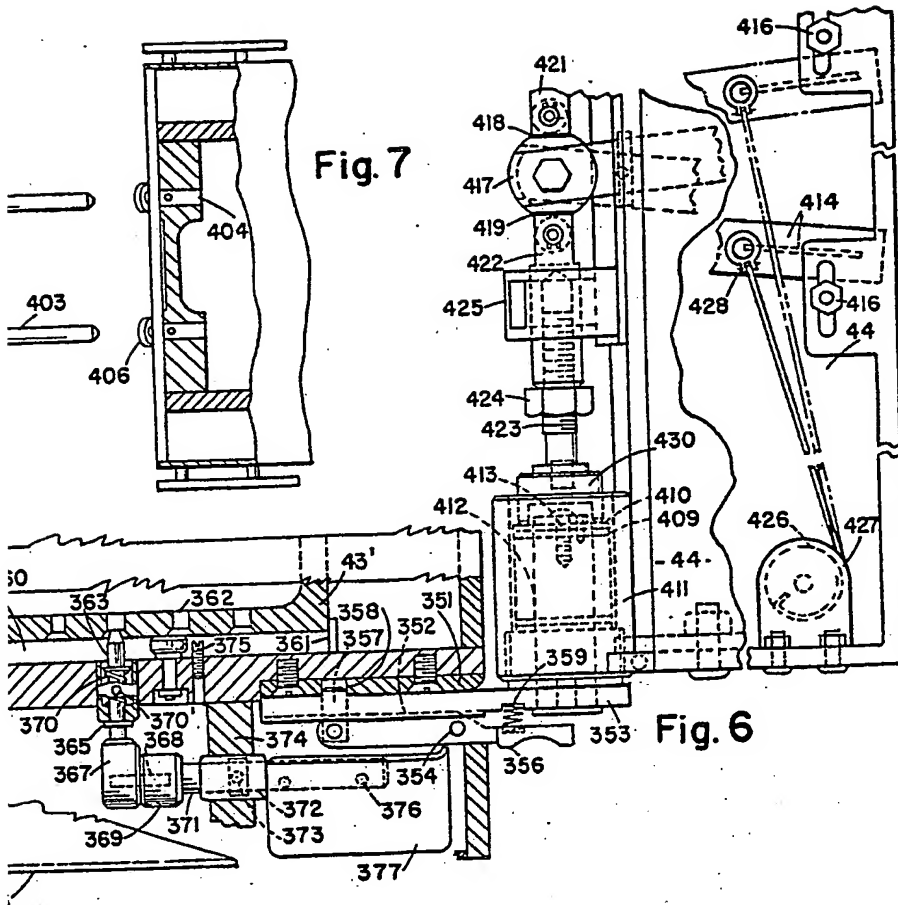


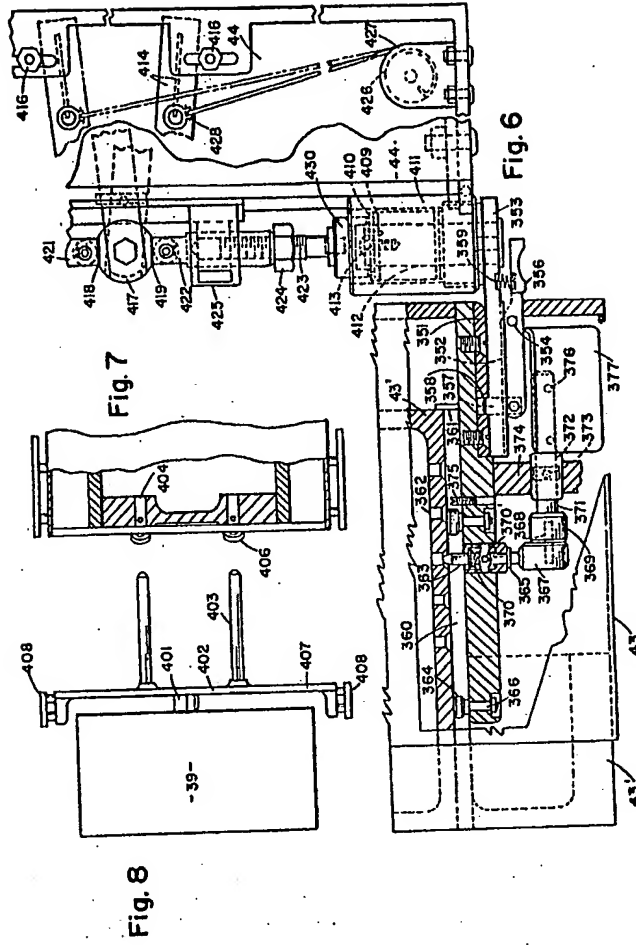
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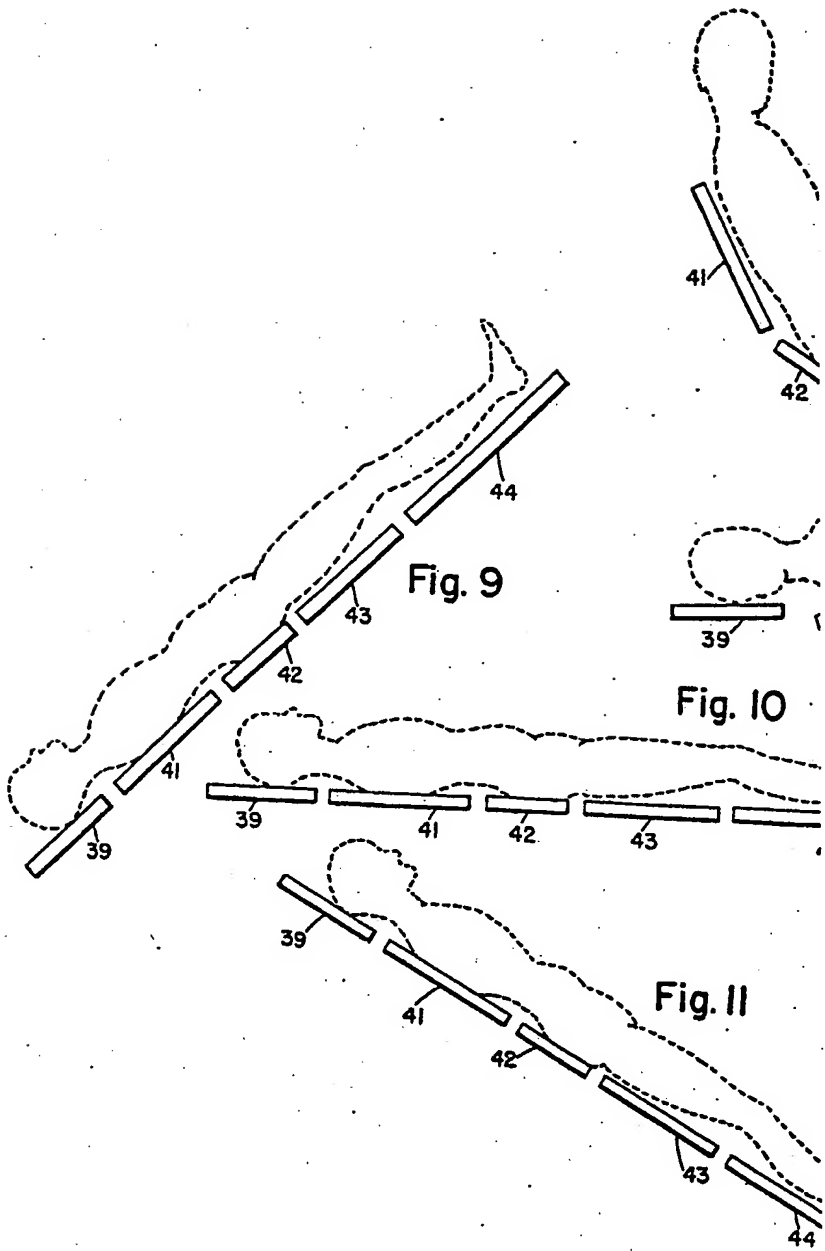
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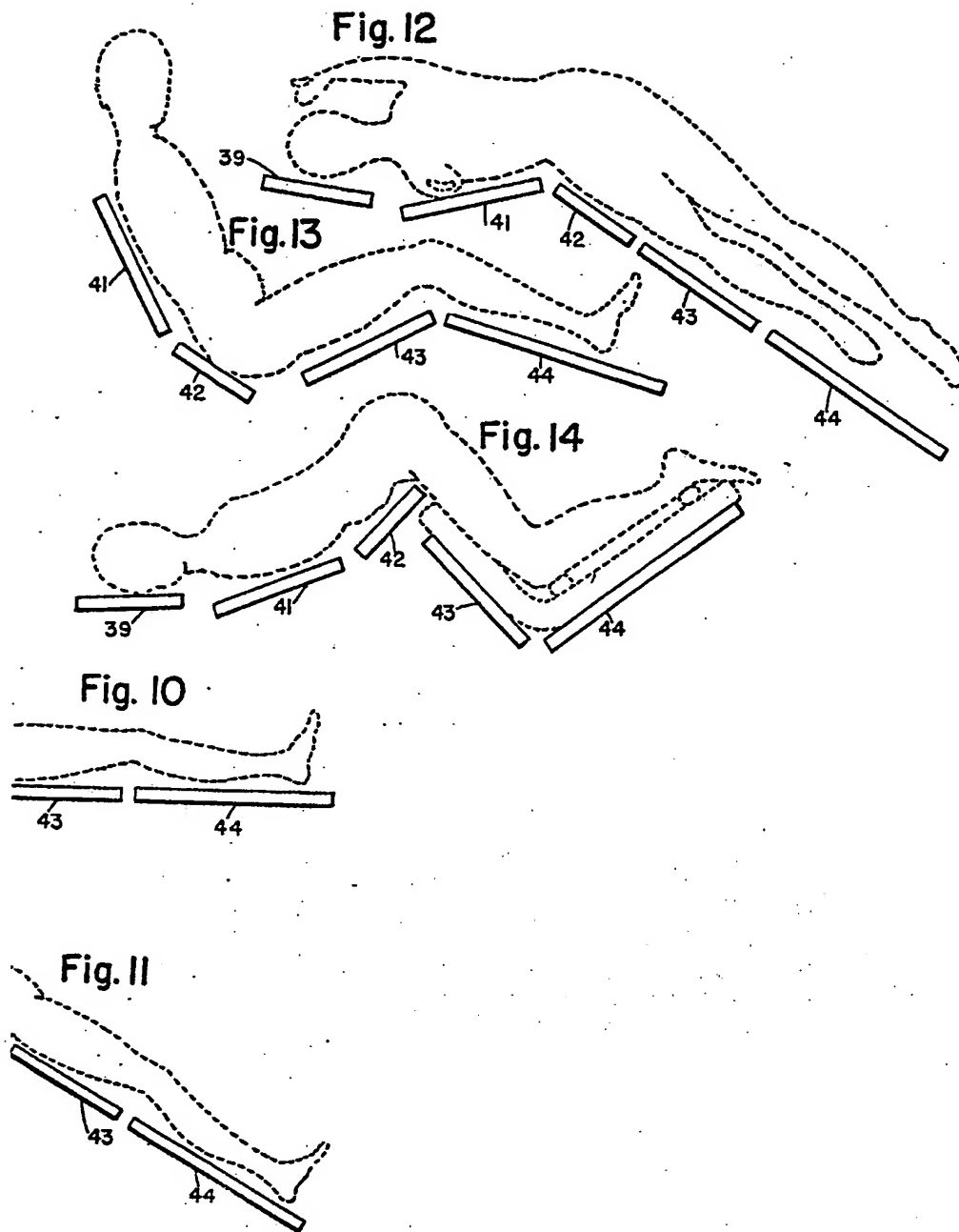
3 SHEETS

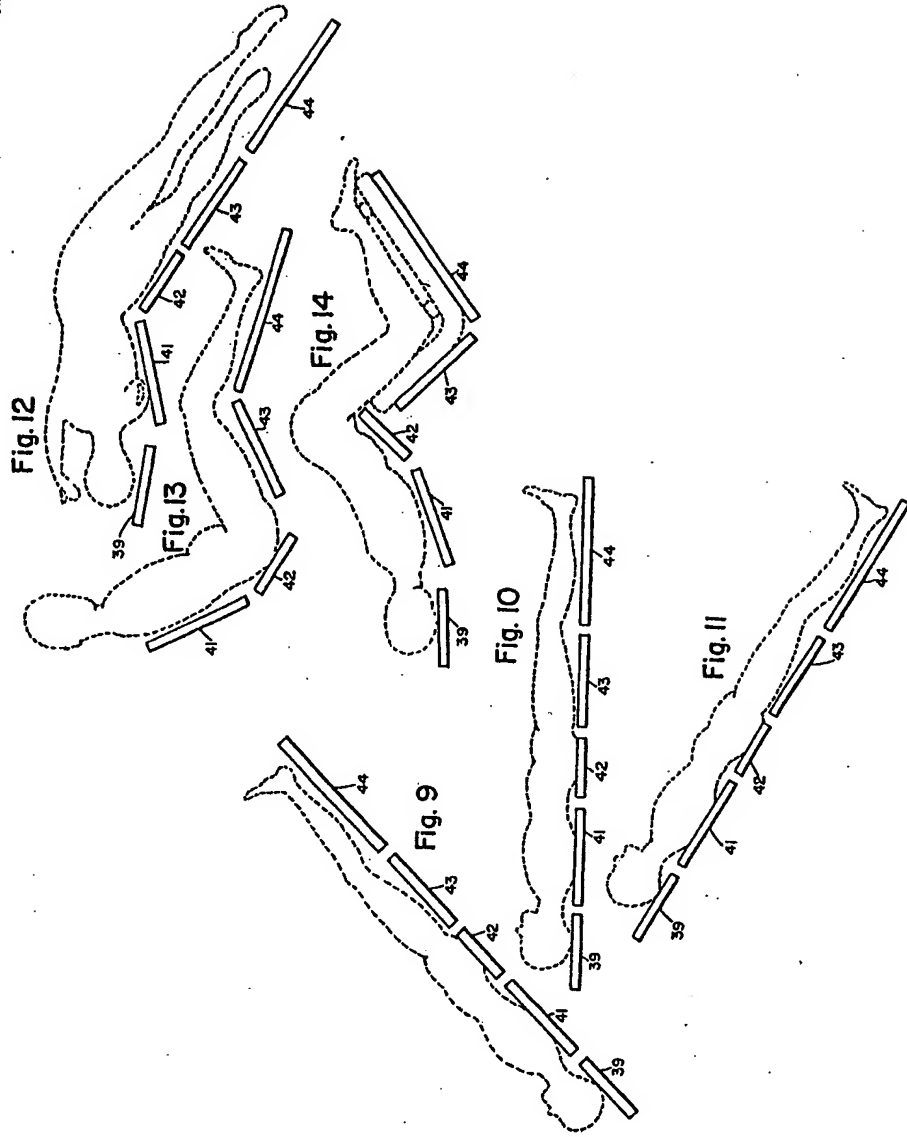
This drawing is a reproduction of  
the Original on a reduced scale  
Sheet 2













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